Riding the lake heatwave: the importance of nutritional context and cooler temperatures between the heat-peaks for ectotherms' survival

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Résumé

Lake heatwaves are becoming increasingly frequent, intense, prolonged and compromising for aquatic organisms' survival. Thermal tolerance, defined as the ability to withstand extreme temperatures, serves as a predictor for species' persistence and distribution across ecosystems. This tolerance depends on the duration and the intensity of the heat-stress, previous exposure to high temperatures as well as nutritional context. During heat stress, organisms gradually accumulate damage eventually reaching a dose threshold where death occurs. Even during a heatwave however, temperature fluctuates and heat-peaks are separated by cooler periods during which surviving organisms may recover by repairing accumulated damage and even increasing their tolerance for the upcoming temperature peak (i.e. hardening). While a lot of research effort has been directed towards heat-peaks, the importance of recovery periods was neglected. Here, we investigate the effect of recovery temperature (18∘,20∘,24∘,26∘, 28∘,30∘C) and duration (2h, 12h) on the heat tolerance of the model organism *Daphnia magna*, submitted to different nutritional contexts (PUFA- and sterol-rich vs PUFA- and sterol-poor). *Daphnia* exposed to high quality and recovery temperatures below 28∘C were able to recover their initial heat-tolerance for 12h. In the shorter recovery treatment (2h) the higher recovery was observed at 24∘C suggesting a unimodal response to recovery temperature. Low food quality hindered short-term (2h) recovery across all temperatures, while in the 12h recovery treatment we only observed recovery at 20∘C, further suggesting a unimodal dependence to recovery temperature. Overall, our results underline the importance of considering both the recovery period and the nutritional context to predict the long-term impact on organisms' survival during prolonged heatwaves.

Mots-Clés: Thermal tolerance, heatwave, recovery, food quality

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